Abstract Submitted to the
International Conference on Strongly Correlated Electron Systems
University of Michigan, Ann Arbor
August 6-10, 2001

Contributions of quadrupolar transitions to the magnetic spectroscopies of rare earth compounds

Claudia Dallera[1], Michael Krisch[2], Andrej Rogalev[2], José Goulon[2], Francesco Sette[2]

[1] *INFM - Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano, Italy*

[2] *ESRF, BP 220, F-38043 Grenoble Cedex 09, France*

The interaction of $4f$ electrons with the delocalized conduction band is responsible for almost all the magnetic effects in rare earth compounds. Experiments of X-Ray Magnetic Circular Dichroism (XMCD) at the $L_{2,3}$ edges of rare earths provide information about $5d$ states but are complicated by quadrupolar transitions to the strongly localized $4f$ shell. It has been shown that Resonant Inelastic X-Ray Scattering (RIXS) clearly identifies these transitions*. We present RIXS results on the isoelectronic ${}^8S_{7/2}$ compounds EuS, GdS and Li_2TbF_6, measured with resonant excitation across the $2p_{3/2}$ level of the rare earth component. States of $4f$ and $5d$ orbital nature overlap in the case of Eu^{2+} but are clearly separated in Gd^{3+} and Li^{4+} (quadrupolar transitions have been seen in RIXS spectra of Eu^{3+} in $Eu_3Fe_5O_{12}$ thanks to larger $4f$-$5d$ distance). We also show that $L_{2,3}$ XMCD of EuS and Li_2TbF_6 is controlled by $4f$ - $2p$ exchange interaction and is affected by quadrupolar excitations. Finally, XMCD at S K edge of EuS indicates strong hybridization of S $3p$ states with Eu $5d$ and $4f$ states, suggesting that indirect exchange via $5d$ states drives EuS ferromagnetism.

*C. Dallera, M.H. Krisch, A. Rogalev, C. Gauthier, J. Goulon, F. Sette, and A. Sole, Physical Review B 62, 7093 (2000)